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DOES CASH CROPADOPTION DETRACT FROM CHILDCARE PROVISION? EVIDENCE FROM RURAL NEPAL

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ABSTRACT

Using data from fieldwork conducted in Nepal, the impact of a project designed to commercialize vegetables and fruits—the Vegetable and Fruit Cash Crop Program (VFC)—on male and female time allocation is examined. Using a rigorous time collection methodology, activity patterns in households that adopt and do not adopt the new technology are profiled. Very few studies examine changing activity patterns of both men and women in response to commercialization of agriculture. Though women's time is valuable in agriculture, it is also valuable in the production of child nutrition. The recent evolution in thinking as to the causes of child malnutrition—the three pillars being food intake, health, and time to care—warrants further analyses of the time trade-offs that women and men face when adopting new agricultural technologies.

The VFC program was successful at targeting both men and women farmers in the sense that household participation resulted in increased head male and head female time spent growing vegetables and fruits. The responses varied, however, by the number of preschool children in residence. In households with more than one preschooler, the time trade-offs associated with VFC participation were not sizeable for the care of children under 5 years. In households with just one preschooler, the trade-offs were more important. In these households, preschoolers received less care from the male and female heads, who spent more time in both the cash crop and in the food crop. In these same households, the nonwork (leisure) time of men increased as a result of VFC participation, but for women, leisure time was unaffected. Thus in the short run, there is perhaps scope for protecting childcare time by reducing time to leisure. In the medium run, benefits may well accrue to unborn preschoolers if VFC participation empowers women.

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1. INTRODUCTION

The reduction of rural poverty is one of the greatest challenges the Government of Nepal faces. Since most of the country's agricultural production is semi-subsistence-oriented, increased commercialization of this rural-based economy is essential for poverty reduction and economic growth. Consequently, farm output diversification and productivity improvements are priority areas for the government (Nepal 1998). In general, the commercialization of subsistence agriculture is fundamental to economic growth in developing countries. The key issue is not as much whether, but *how* subsistence agriculture should be transformed (von Braun and Kennedy 1994).

There are ways in which agricultural commercialization could have negative consequences for the poor, such as the concentration of land tenure and a less varied diet characterized by the purchase of empty calories. In general, the literature indicates that agricultural commercialization is associated more with missed opportunities for improving welfare than with deterioration in welfare of the poor. For example, increases in household income that are generated for many (but not all) of the poor cannot be converted into improved nutrition due to weak financial markets for seasonal consumption smoothing, and weak health infrastructure (von Braun and Kennedy 1994).

Despite a conceptual literature on gender and development that provides the scope for a focus on both men and women (Cornwall 1997; Engle 1997; Moser 1993; Paolisso, Gammage, and Casey 1999), there are not many quantitative studies that focus on men

and women's roles and how they respond to new economic opportunities in rural areas.[1] Some case studies infer that women's individual productivity and access to resources decline as households increase commercial crop production (von Braun and Webb 1989; Buvinic and Mehra 1990). Others indicate that commercialization is not necessarily associated with increased workloads for women (Bellin 1994; Bouis and Haddad 1994; McComb et al. 1994; Peters and Herrera 1994). Very few studies examine the changing activity patterns of both men and women in response to commercialization of agriculture (Wilk 1989; Lockwood 1992). And even fewer collect rigorous time allocation data on these patterns.

Nearly all of the commercialization studies focus on initiatives that were not consciously designed to be accessible to women. Perhaps the best study of a commercialization intervention designed specifically to benefit women is from The Gambia (von Braun and Webb 1989). The commercialization of rainfed rice—traditionally a woman's crop—was so successful that men took over the rice crop. Women were faced with two choices: retain traditional rice cultivation methods but move to more marginal land, or work on the newly-controlled male rice plots.

If women's time is valuable in agricultural cultivation, it is also valuable in the production of child nutrition. The past 10 years has seen a revolution in the conceptual model underlying child malnutrition. Specifically, there is now a recognition that care of

[1] A few studies have examined family labor supply, that is, how time allocation and work of individual household members responds to the activity patterns of other members of the same household (Abdulai and Delgado 1999; Huffman and Lange 1989; Jacoby 1993; Kimhi and Lee 1996; Newman and Gertler 1994; Skoufias 1993). None of these, however, have examined responses to agricultural commercialization opportunities.

children is at least as important to their growth and nutritional status as are food intake and health, and water and sanitation services. Care behaviors include breastfeeding, psychosocial stimulation, food preparation and food storage practices, and hygiene practices (Engle, Menon, and Haddad 1999; Haddad 1999; Quisumbing et al. 1995; Ruel et al. 1999; Udry et al. 1995; World Bank 1998). The evolution in thinking as to the causes of child malnutrition warrants further analysis of the time trade-offs that women and men face when adopting new agricultural technologies.

This paper attempts to address these issues by using data from fieldwork conducted in Nepal to examine the impact of a project designed to commercialize vegetables and fruits—the Vegetable and Fruit Cash Crop Program (VFC)—on male and female time allocation. We use a rigorous time collection methodology to profile the activity patterns of men and women in households that adopt and do not adopt new technology that allows the commercialization of fruits and vegetables. We model the adoption decision and estimate the impact of adoption on men and women's time allocation patterns in various key activities.

Findings from our multivariate analysis suggest that for households with one preschooler, VFC participation results in more time to agricultural production of the cash crop for both men and women, but also decreases care time to preschoolers from both men and women. For households with more than one preschooler this trade-off is not so apparent. Our analysis also suggests that behavior change initiatives to protect time to child care might be feasible in that VFC participation does not decrease the overall nonwork time of men or women with preschool children in residence.

2. THE VEGETABLE AND FRUIT CASH CROP PROGRAM (VFC) IN NEPAL

The findings presented below are based on fieldwork completed in 1991–1993 in the Rapti Zone, Mid-Western Development Region, Nepal.[2] In Nepal, women's farm contributions are critical to household production of food and cash crops (Acharya and Bennett 1981; Bhatt et al. 1994; Cooke 1998; Kumar and Hotchkiss 1988; Paolisso and Regmi 1992; Paolisso et al 1994). Beginning in the late 1980s, farmers—both men and women—throughout Rapti were encouraged to commercialize their vegetable and fruit production in order to generate income and meet growing local and national demand for fruits and vegetables. Development assistance to farmers in Rapti was provided by the Rapti Development Project (1985-1995).[3] Within the project's focus on agriculture, the Vegetable, Fruit, and Cash Crop (VFC) program was developed to focus exclusively on vegetable and fruit commercialization.

The overall goal of the VFC program is to increase the commercial value of the vegetable and fruit production and raise household incomes of targeted farmers (men and women) in the Rapti Zone. Implemented by a Nepalese development organization, the

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[2] The data were collected as part of the Gender and Farm Commercialization Study (GFCS), an applied research project that investigated the consequences of agricultural commercialization for men and women farmers in the Rapti. GFCS was supported by the U.S. Agency for International Development (USAID). Joint funding was provided by the Office of Agriculture and Rural Development (USAID/Nepal) and the Office of Women in Development (USAID/Washington). GFCS project design and field research were undertaken jointly by the International Center for Research on Women (ICRW), a policy research center located in Washington, D.C., and New ERA, a research and development organization located in Katmandu, Nepal. To strengthen the analysis and comparative usefulness of the data collected in Nepal, ICRW and New ERA accepted an invitation by the International Food Policy Research Institute (IFPRI) to integrate the GFCS data into their multicountry database on gender and agriculture.

[3] The Rapti Project, and its successor, the Market Access for Rural Development (MARD) project, support the Government of Nepal's national development plans to strengthen and diversify agricultural production.

program seeks to build the capacity of farmers to shift to a more commercial production of vegetables and fruits for local and national markets, thus promoting local income generation and reducing vegetable and fruit imports from India.

The VFC program provides production inputs, training, and technical assistance to both men and women farmers. The specific vegetables and fruits provided vary according to agroclimatic conditions and existing agricultural practices. Although men and women were both provided with training and technical assistance on how to both grow and process vegetables and fruits, women received more training on processing vegetables and fruits into jams, jellies, pickles, chips, and brandy, activities that were perceived as compatible with their other domestic activities. The main emphasis of men's VFC training and technical assistance was on in-field production, storage, and marketing activities. Although women received less training on these latter activities, they did, nonetheless, often work alongside men in the growing of vegetables and fruits, time permitting.

3. EMPIRICAL APPROACH

This section describes the model to be estimated, the communities selected for data collection, the types of data collected, and the implications for the estimation approach.

ESTIMATED MODEL

Our empirical approach begins with the recognition that the roles taken on by males and females—while culturally constructed—can be shaped by economic and technological forces (Yelland and Grieshaber 1998). The overall approach is to first model participation in the VFC program and then examine the impact of participation on male and female labor supply in four activities related to a possible trade-off in time to crop production and time to child care. An instrumental variables framework is used to reduce the bias on the estimated impact of VFC participation.

A standard household utility function approach can be used to derive labor supply equations for male and female labor in various activities.[4] Working through the first-order conditions for constrained utility maximization leads to labor supply being a function of wage rates in various activities, individual characteristics such as age and educational attainment, household size and composition, and community characteristics.

If we make the strong assumption of the separability of production and consumption, market wages will provide an exogenous measure of the value of time of family labor, irrespective of whether family members choose to work on- or off-farm. In such a case, community dummy variables are sufficient proxies for community wage rates. How valid is this assumption in the communities for which we have data? If all adult men and women allocate some of their time to off-farm activities (nonfarm self-employment and nonfarm wage employment), then the assumption is likely to hold.

[4] See, for example, Abdulai and Delgado (1999) and Skoufias (1994).

However, only 47 percent of adult men and 15 percent of adult women are engaged in off-farm labor.

It is unlikely, then, that nonseparability of production and consumption can be rejected in our sample. If so, how can nonseparability be dealt with? Ideally, we would need to estimate production functions in the key labor supply categories to estimate shadow wage rates. Unfortunately, the data are not available to undertake such a detailed production function analysis. Another strategy is to undertake a general production function analysis that sums over crops and individuals. The data exist to do this; however, this would be difficult to undertake without panel data on farmers, because factors such as innate talent cannot be controlled for. Hence, our estimates on shadow wages will be biased and nonspecific in terms of gender.

Finally, one can treat shadow wage rates as omitted variables in our labor supply functions for cash and noncash crops. Is the key variable of interest—VFC participation—likely to be correlated with the omitted shadow wage rates (which would now be relegated to the composite error term)? The identifying instrument we use in the VFC participation equation is "distance from the household to the VFC office." The exact factors determining the placement of the VFC offices are not known to us. If we assume they are unrelated to factors that affect labor productivity in agriculture (e.g., land quality and access to other inputs), then the omission of shadow wage rates will not bias the instrumental variables estimate on the VFC variable. This latter assumption is plausible—it is generally political and institutional factors that determine the location of such

offices—not land quality or even access to roads. For these reasons, we choose to treat shadow wages as omitted variables in our time allocation regressions.

SAMPLE COMMUNITIES

At the time of fieldwork the VFC program was active in 22 communities in the five districts in Rapti. Budgetary and logistical concerns—mainly travel constraints—limited the number of study communities to three. Satbariya, Jinabang, and Thabang were selected as representative of the diversity of the 22 communities in terms of ethnic composition and differences in agroecological and market conditions. The VFC program provided technical assistance and crop technologies to the three communities at a level sufficient, it was hoped, to achieve demonstrable results in a relatively short time. It was also believed that the constraints to VFC production observed in the communities would be similar to those found in the other VFC communities throughout the Rapti area. Such constraints would include distance to markets, dependence on existing production of grains and livestock, availability of household and hired labor, and possibly the existing gender division of labor.

The communities of Satbariya, Jinabang, and Thabang represent different agroecological zones, ethnic groups, and different agricultural strategies due to differences in local environmental conditions, access to markets, and cultural practices. Satbariya is a lowland community located in the lower plains of the Deukhuri Valley, with easy access to highway transportation. The dominant ethnic group is Tharu. Most households also rely on livestock production to meet subsistence needs. The principal

activities promoted by the VFC program were the planting of seed and ware potato, vegetables and fruit (mango, limes, guava) nurseries, and the making of potato chips and *achar* (pickles).

Jinabang is a middle hill community located within a few days' walk from Tulsipur, the headquarters for the Rapti Zone. The ethnic groups present are predominantly Chhetri, followed by Magar and the artisan castes. The principal activities promoted by the VFC program include seed and ware potato, vegetables, and apple orchards and nurseries, and the processing in jams, jellies, noodles, and chips from them.

Thabang is an upper hill community located at 2,200 meters above sea level and two to three days' walk from larger towns or vehicle roads. The dominant ethnic group is Kham Magar. The principal VFC activities include the promotion of seed and ware potato, vegetables, and apples, and the processing into jams, jellies, and chips from them. It should also be noted that women in Thabang also make apple brandy, which they profitably sell to men in and outside the community. Women in Thabang also received assistance from the VFC program in carpet weaving, a highly profitable income-generating activity that was established prior to the VFC program.[5]

SAMPLE HOUSEHOLDS

A total of 264 households were selected for the study. The first step in selecting the sample was to complete a sampling frame survey in the three communities. The

[5] Additional ethnographic information for these study communities can be found in Paolisso and Regmi (1992).

purpose of this short survey was to collect selected baseline cultural, demographic, and agricultural production data. Of particular interest was the identification of how many households were participating and not participating in the VFC program. Prior to undertaking the survey, a definition of household participation in the VFC program was established, based on initial ethnographic work in the communities.

VFC households were defined as meeting any one of the following criteria: (1) received training through the VFC program and are actively using the improved technologies to grow vegetables, fruits, and other cash crops for local markets; (2) received training through the VFC program and are actively using the improved technologies to grow vegetables, fruits, and other cash crops for home consumption only; (3) received training through the VFC program and are using the improved technologies to grow vegetables, fruits, and other cash crops to a moderate degree; or (4) did not receive training through the VFC, but used the improved technologies via diffusion from those who did receive the training. Based on this definition, the communities have different levels of participation in the VFC program (Satbariya = 19 percent, Jinabang = 72.7 percent, and Thabang = 43.8 percent). Nonparticipating households do grow vegetables and fruits, but use traditional crop varieties and farming practices.

The sampling frame data reveal that Satbariya had only 44 VFC households. This provided the basis for selecting a random sample of 44 households in each community that used the technology and a random sample of 44 who did not. However, this sampling approach creates a situation where the probability that a household is selected differs by community. This choice-based sampling could lead to biased estimates of regression

parameters (Manski and McFadden 1981). We eliminate this potential source of bias through the use of sampling weights in all regressions, with each weight defined as the inverse of the probability that a household was included in the study. A household survey was administered to each of the 264 households (132 in VFC and 132 not), covering a range of subjects including the demographic composition of the household, its assets (including landholdings), and the education of the household members. In addition, a detailed time allocation survey was conducted for each adult member of the household using the random spot observation method during the 12-hour period between 6:30 and 18:30 (Paolisso and Regmi 1992).

For the purposes of the following analysis, we equate VFC participation solely with the receipt of VFC training (any one of criteria 1–3 above). Households that did not receive VFC training but use the improved technologies via diffusion (criterion 4 above) demonstrate very low levels of usage, and hence are treated as non-VFC households. This narrower definition of VFC participation reduced the percent of VFC households in the sample to 38.

DATA COLLECTION METHODS

A number of data collection techniques were used to obtain qualitative and quantitative information on the production and consumption patterns of households participating and not participating in the VFC program in the three communities. The principal approaches were survey questionnaires, random spot observations of time allocation, ethnographic techniques, and rapid rural appraisals (Paolisso and Regmi

1992). One innovation of this study is the combination of socioeconomic data with detailed time allocation data collected through the use of random-spot observation.

The random-spot observation for time allocation data collection involves recording the activity of individuals within the 6:30–18:30 time period by visiting them randomly 30 times within this window during the course of a 12-month period and observing and recording their activity. This is a much more accurate indicator of time allocation than a single 24-hour recall (as is typical in the few studies that record time allocation). The latter method is subject to more random measurement error, more recall bias linked to respondent characteristics, and is more vulnerable to seasonal changes (Gross 1984). Because the changes in time allocation we record are yearly averages, we feel that they are reliable estimates of observed changes in real behavior.

By focusing on the 6:30 to 18:30 time period, we capture the activities that are directly and indirectly affected by any changes in farming practices due to the adoption of VFC technologies. These activities include agricultural labor, childcare, non-evening meal and very-early morning food preparation and processing, and fuel and water collection. None of these activities can be deferred or rescheduled to any significant degree. Furthermore, the main evening activities (evening food preparation, basket fixing, eating, etc.) are unaffected by VFC participation. No in-field agricultural work is done during the evening, and no meetings with VFC extension workers were held at night. It should also be noted that attempts to undertake "after-dark" random visits to the household during the 16:30–6:30 period would have been impractical, dangerous, given the rugged hill terrain, and an unacceptable invasion of the study subjects' privacy.

Finally, attempts to supplement daytime spot recall data with nighttime recall data have proved uninformative (Baksh et al. 1994).

4. RESULTS

Our analysis focuses on three related questions. First, what are the determinants of household participation in the VFC program? Second, how does head male and head female mean time allocation among various activities differ by VFC participation status? And third, how does VFC participation affect head male and head female labor allocation to various activities while controlling for a number of individual and household characteristics including the household's self-selection into the VFC program?

DETERMINANTS OF HOUSEHOLD PARTICIPATION IN VFC

Probit regression analysis was used to estimate the likelihood that a household would have received VFC training. Explanatory variables were selected on the basis of being identified as important in ethnographic analysis of VFC participation (Paolisso and Regmi 1992). The set of determinants includes age and literacy of the household head, household size and composition, ownership of assets, and time required to reach the local VFC field office. This last variable is used as an identifying instrument in that we assume

it affects whether VFC training is received, but not the labor allocation decisions between VFC and non-VFC crops, other than through VFC training.[6]

Using these variables, we predict the likelihood of VFC participation for each household. This predicted value will be continuous and take a value between zero and one. Predicted VFC participation is then included as an exogenous explanatory variable in the analysis of the determinants of the allocation of male and female time to VFC activities and to cereal and livestock activities. Because VFC participation enters the labor allocation equations as a predicted variable, estimates of the impact of VFC on labor allocation will be consistent but imprecise. In an effort to correct the standard error of the parameter estimate on predicted VFC participation, we employ the bootstrap estimation technique.[7]

Summary statistics for the variables used in the VFC participation and the labor allocation regressions are presented in Appendix Table 5. The results of the probit regression are presented in Appendix Table 6.[8] Statistically significant regressors that increase the probability of household participation in the VFC program include whether

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[6] We cannot test this assumption directly because we have one possibly identifying instrument; however, the ethnographic analyses reported in Paolisso and Regmi (1992) support our assumption that the time required to reach the VFC offices affects the receipt of VFC training but not the time allocated to vegetables and fruit or livestock and cereals.

[7] This amounts to estimating the full decision tree many times over, with N observations being drawn each time with replacement from the N observations; in this random drawing, some of the original observations will appear once, some more than once, and some not at all. At each pass (called a replication), the estimator is applied to the data and the resulting parameter estimates are saved as a data set. Using the collection of estimated parameter sets from these replications, one can calculate the standard deviation of each statistic, which is an estimate of its standard error (StataCorp 1997). Our estimates are based on 500 replications.

[8] Only 244 of the 264 households have complete time allocation for head adults. Only these 244 are used in the probit and instrumental variables regression.

the household head is literate and residence of the household in Jinabang relative to Thabang. Household heads that are literate are better prepared to learn how to obtain and use the new technologies for commercially producing vegetables and fruits. It is also not surprising that the community variable of Jinabang is a significant predictor of household VFC status, given this community's enthusiastic acceptance of VFC training.

Statistically significant variables that decrease the likelihood of household participation in the VFC program include residence in Satbariya (relative to Thabang) and time to reach the VFC extension office. Of the three communities, Satbariya had the lowest level of VFC participation and the lowest level of surplus vegetable and fruit production for market sale. The farther the VFC extension office is from the household, the less day-to-day contact households have with extension agents, and thus the increased reluctance to commit resources to the new vegetable and fruit technologies. Interestingly, neither the household demographic variables nor the amount of land owned affected the likelihood of household participation in the VFC program.

Not many variables emerge as significant in their ability to explain VFC participation. More parsimonious specifications result in better looking Z-statistics, but with no variables other than those already described emerging as significantly different from zero. This suggests that self-selectivity into the program is not strongly associated with observed characteristics, at least the ones we were able to measure. As the subsequent econometric estimation will show, VFC participation is predicted with

sufficient precision for it to be significantly different from zero in nearly all of the second-stage time allocation equations.[9]

TIME ALLOCATION OF HEAD MALES AND FEMALES BY VFC PARTICIPATION

Detailed data were collected on the amount of time household members spent in domestic, social, and economic activities (Paolisso and Regmi 1992).[10] We choose to focus on the time allocation of head adults because they are the prime decisionmakers within the household and we can be more sure that changes in their own time allocation are a direct reflection of their own—and not someone else's—preferences.[11]

In 185 out of the 246 households included in our multivariate analysis, the head male and his spouse is designated by the household as the key decisionmakers. In two cases, the head male's first wife is not in residence, so his second wife is the head female. In addition there are 8 cases out of 244 with two wives in residence, and the older is

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[9] Note that Appendix Table 6 also presents probit results for the subsample of 168 households that have preschoolers. Also note that the two sets of probit results are very similar. We chose to use the predicted VFC participation from the full sample of households when undertaking time allocation regressions on the subset of 168 so as to make use of all the information available to us as to the probability of these households joining the VFC program.

[10] Random spot observation of all members of the study households was completed for a one-year period (February 1991–January 1992). Field staff visited eight randomly selected study households on a daily basis in each community between 6:30 A.M. and 6:30 P.M. to observe and record the activity of all household members at the time of the visit. All activities were recorded using short descriptions and activity codes. For further details of this method of time allocation data, see Baksh (1990) and Russell and Killworth (1993).

[11] We are interested in the time allocation behavior of the key male and female decisionmakers and therefore we give much weight to self-reported headship status and to marriage and kinship relations to the household head. It is true that there are other ways to identify decisionmaking ability (who earns the most income, who works the most in economic activities, who is the oldest, etc.), but our choice relies on prior ethnographic work in the three communities on the spheres of decisionmaking (Paolisso and Regmi 1992).

designated head female. In cases where the female spouse is not in residence or is unable to undertake the responsibilities of the head female, the responsibilities pass to the oldest daughter or daughter-in-law. In our dataset, 45 out of the 246 households have an older daughter or daughter-in-law as the head female. Finally, there are six cases where another female relative has assumed the responsibilities of the head female. Although we have different female members identified as the head female, the activities undertaken and their responsibilities are similar (Paolisso 1995). The corresponding method was used to define the "head male" and "head female" in female-headed households. Each household therefore contains a head male and head female.

Table 1 describes a number of interesting patterns that set the stage for the following multivariate analyses. First, the time of head females (15 versus 30 minutes) and head males (28 versus 68 minutes) in vegetable and fruit cultivation in VFC households is double that of non-VFC households. Second, women in VFC households spend more time in cereals and livestock (235 minutes versus 224) while men in VFC households spend less time (225 versus 256 minutes). Third, women from VFC households spend less time in nonwork activities (94 versus 115 minutes) while men in VFC households spend more time in nonwork activities (164 versus 148 minutes). Note, however, that the average time women in VFC households spend in nonwork activities still represents 13 percent of the time between 6:30 and 18:30 (i.e., 94 minutes

Table 1: Time allocation of head male and female by VFC status (minutes per 12-hour day)

	Head male		Head female	
Activity	**VFC**	**Non VFC**	**VFC**	**Non VFC**
Missing	3	4	6	4
Eating and drinking	20	20	30	28
Food preparation	12	7	121	114
Care to self and others	31	25	51	55
Care of under 5 year olds	10	11	32	34
Care to self and those 5 and older	21	13	19	21
Household chores	72	84	115	114
Cereals and livestock	225	256	235	224
Vegetables and fruit	68	28	30	15
Other cash crop	12	14	6	7
Off-farm	57	82	7	7
Inactive	46	50	58	68
Sick	6	7	6	5
Out of location	43	27	5	10
Education	2	2	5	3
Recreation	27	32	9	12
Social	91	66	27	35
Other	6	16	8	19
TOTAL	720	720	720	720
Leisure (sum of Inactive, Social and Recreation)	164	148	94	115
Number of households	93	151	93	151

out of 720). Fourth, note that men and women's care time to under 5 year olds does not vary by VFC participation.[12]

Table 2 breaks these numbers out for the most relevant time categories by the number of young children (ages 0–4.9 years) that are members of the household. We do this because young children are time-intensive and are likely to affect the head woman's time allocation and the nature of the trade-offs she has to make between income generation and the health generation of her children. This disaggregation makes cell sizes small and any observations made on the basis of Table 2 should keep this in mind.

[12] In the questionnaire, care includes over 30 activities, such as washing and bathing, putting to bed, dressing, comforting when crying, treating wounds, home schooling, taking to clinic, and holding/carrying.

Nonetheless, several patterns are noteworthy. First, women's time in care of preschoolers does not appear to vary by VFC participation—for any number of preschoolers. Second, women's time in vegetables and fruit seems more downwardly sensitive with increasing numbers of preschoolers in the VFC participant group than in the non-VFC group. Third, VFC women's time spent in cereals and livestock is smaller for households containing a greater number of preschoolers, a pattern also noted for women in non-VFC households. Fourth, women's nonwork time, regardless of VFC status, is not sensitive to the number of preschoolers in the household. For men, no clear patterns emerge once the data are disaggregated by the number of preschoolers.

Table 2: Time allocation of head male and female by VFC status, by number of preschool children in the household (minutes per 12-hours day)

Time activity, by male or female	VFC					Non-VFC					VFC	Non VFC
	Number of children age 0-4.9 years in household:											
	None	One	Two	Three	>3	None	One	Two	Three	>3	All	All
Head male												
Cereals and livestock	206	265	239	168	143	221	249	288	264	282	225	256
Vegetables and fruit	88	46	65	117	18	23	19	32	47	56	68	28
Care to those under 5	0	12	18	7	22	0	17	20	13	0	10	11
Leisure	154	146	155	194	307	166	139	144	121	131	164	148
Head female												
Cereals and livestock	237	257	243	196	121	250	214	219	209	162	235	224
Vegetables and fruit	42	30	17	22	22	16	15	12	24	22	30	15
Care to those under 5	0	39	53	71	31	0	39	57	56	37	32	34
Leisure	99	75	97	126	112	126	122	94	111	171	94	115
Number of households	29	31	19	9	5	47	36	51	10	7	93	151

Because households are not randomly allocated to VFC and non-VFC groups, it is dangerous to draw hard conclusions about the impact of the VFC program on adult time allocation from Tables 1 and 2, even if some of the above differences were statistically

significant. The next section uses multivariate techniques to determine the impact of VFC on the time allocation on (1) the most important time activity in terms of time allocated to it (cereal and livestock cultivation), (2) the time activity that the VFC program is targeting (vegetable and fruit cultivation), (3) the time activity that is most directly crucial to good child nutrition (care to children under 5 years), and (4) the time activity that best reflects the total work time burden (nonwork time or leisure).

THE IMPACT OF VFC PARTICIPATION ON TIME ALLOCATION

Instrumental variables regression was used to estimate the independent effect of the VFC program on the four time activities, both for head men and for head women. The sample of households is restricted to those with at least one preschooler (168 out of 244 households). Thus the regression results are conditional on having a preschooler in the household.[13] The full regression results are presented in the Appendix Tables 7 and 8.

[13] Regression results for time to cereals and livestock, vegetables and fruits, and leisure are similar for the sample of 168 and 244 households. The latter results are available from the authors. We make the assumption that fertility decisions are not influenced by participation in the VFC program.

Tables 3 and 4 summarize the results for the estimates of greatest relevance to the issues posed in this paper.[14]

While the other variables included in the regressions are considered to be important, particularly as an attempt to control for each household's life cycle position (age of household head) and the unobserved characteristics of each study site (the dummy variables for Satbaryia and Jinabang), the key policy variable is VFC participation (endogenized) and its interactions with the number of preschoolers in the household and we focus our discussion around them.[15]

Table 3 indicates that VFC participation has a positive impact on head female time allocated to the cultivation of livestock and cereals and to vegetables and fruit

[14] The number of zero observations on time in vegetable and fruit activities and on time in care (both to those under 5 and to those 5 and over) was greater than 10 percent for both head men and women (see table below).

	Percent with values equal to zero	
Dependent variable	All 244 households	168 households with preschoolers
Head female cereal livestock time	5	4
Head male cereal livestock time	6	3
Head female VFC time	45	46
Head male VFC time	34	30
Head female care time (all care)	24	18
Head male care time (all care)	43	39
Head female care time (care of <5 years)	53	32
Head male care time (care of <5 years)	73	61
Head female care time (care of >=5 years)	45	48
Head male care time (care of >=5 years)	59	61
Head female leisure time	6	5
Head male leisure time	5	4

Given these circumstances we used Tobit IV estimation for these dependent variables. With a large proportion of zero values in the dependent variable, this estimator avoids the asymptotic bias of OLS. See Tobin's (1958) original discussion of demand for consumer durables. If desire to purchase the good was high enough, desire was measured by the expenditure on that good. If no purchase was made, the measure of desire was censored at zero. The results were qualitatively similar to the OLS/IV estimation, but with slightly larger estimated coefficients on the VFCP variable.

[15] A number of interaction terms involving VFC participation terms were tried, with the interaction with the number of preschool children being the most robust.

cultivation, and that this positive impact declines as the number of preschool children increases. There is no statistically significant impact on head women's non-work or leisure time and a negative but increasingly less negative impact of VFC participation on time to the care of children under 5 years. The latter relationship was not evident in descriptive Tables 1 and 2. In general, the statistical significance of VFC participation on time allocation in these four categories is stronger for women than for men.

Table 3: Estimates of VFC impacts on cultivation and care activities, head males and head females

	Head males		Head females	
Marginal impact (minutes) of VFC participation (VFCP) on:	**Estimated coefficient on VFCP**	**Estimated coefficient on VFCP*Child 0-4**	**Estimated coefficient on VFCP**	**Estimated coefficient on VFCP*Child 0-4**
Vegetable and fruit cultivation	84*	-20*	81**	-26**
Cereals and livestock	76*	-95*	166**	-102**
Care to children under 5	-95*	31*	-158**	81**
Leisure	-104**	96**	0	0

Notes: Zero indicates that the joint significance level of the estimated coefficients on VFCP and VFCP*Child 0-4 is low (greater than 10 percent). * indicates joint significance at <10 percent and ** indicates joint significance at <5 percent.

Table 4 presents the overall impacts of VFC participation on time allocation by the number of preschoolers in the household. It is clear that VFC participation has a large effect on time to care for children under 5 years. For households with one preschooler, head females in VFC households allocate less time to care for their preschoolers (–77 minutes) compared to head females in non-VFC households. For households with two preschoolers, VFC participation results in an increase of 4 minutes, and for households

Table 4: The impact of VFC participation on head male and female time, by the number of children age 0-4.9 years

Marginal impact (minutes) of VFC participation (VFCP) on:	Head males			Head females		
	Number of children age 0-4.9 years					
	1	2	3	1	2	3
Vegetable and fruit cultivation	64	44	24	55	29	3
Cereals and livestock	-19	-114	-209	64	-38	-140
Care to children under 5	-64	-33	-2	-77	4	85
Leisure	-8	88	184	0	0	0

with three preschoolers, it gives an increase of 85 minutes to care time for children under 5 years. For men, VFC participation negatively affects the time they allocate to the care of preschoolers (from –64 to –2 minutes). These are large effects, particularly given the similar means by VFC and non-VFC groups in Tables 1 and 2. But note that (1) many different factors are being accounted for in the regressions and that we are isolating the independent effect of VFC participation, (2) the range of time to care for children under 5 years is large (see Appendix Table 5), and (3) the extra time to preschoolers as a result of VFC participation has to be divided among the number of preschoolers when there are more than one in the household.

In terms of vegetable and fruit cultivation, VFC participation has a positive effect on both head female and head male time, but an effect that diminishes with the number of preschoolers in the household. Cereals and livestock cultivation increases with VFC participation for women in households with one preschooler. For households with more preschoolers, male and female time to this activity decreases with VFC participation.

5. CONCLUSIONS AND DISCUSSION

The goal of the VFC project was to increase the commercial production of vegetables and fruits in farm households heavily dependent on the production of cereal and livestock for home consumption. Prior to the program, these households had been growing small amounts of vegetables and fruits, again for home consumption. However, the varieties grown and the technologies used did not produce vegetables and fruits of the quality and variety that would make them commercially viable.

The VFC program was successful in its efforts to target both men and women farmers in the sense that household participation in the VFC program resulted in increased head male and head female time spent growing vegetables and fruits. The response of head women's labor to VFC activities, conditional on other factors, ranges from 55 to 3 minutes per 12-hour period for households with one, two, and three preschoolers, respectively. This is a large effect given that it is the average effect over the year. Interestingly, VFC participation increased head male time in vegetable and fruit production more than for head females (64 to 24 minutes).

For the 101 households with more than one preschooler, VFC participation results in increased time—for both men and women—to the VFC crops, vegetables and fruits; less time to cereals and livestock; and greater time to care of children under 5 years by women and moderately less time to care of children under 5 years by men. For these households, the trade-offs associated with VFC participation do not seem too important for the health of the children under 5 years. For the 67 households with one preschooler,

the trade-offs seem more important. In these households, preschoolers receive less care from their parents, who spend more time in cultivation activities, especially in the cash crop, but also in the food crop.[16]

Why might VFC have a less severe effect on time to care for preschoolers when there is more than one in the household? Three reasons spring to mind. First, if there is more than one preschooler in the household, the mother is more likely to recognize the benefits to be gained from caring, based on her experience with the older preschoolers. Second, the mother with more than one preschooler in residence is more likely to have received nutrition education and behavior change messages from nutrition professionals in the community. Third, two preschoolers in residence are likely to be more effective at demanding care than one. It is well known that caregivers are responsive to preschooler communication signals and more preschoolers provide more signals.

Can this care deficit for sole preschoolers be made up by other household members? Even if they do increase the time to caring for preschoolers, the quality of time is less likely to match that of the head male and female, who are typically the parents of these young children. Is this care deficit of great importance to the nutritional status of these lone preschoolers? Certainly more care is better, but a definitive answer to this question can only be addressed with the help of anthropometric data on the preschoolers.

Is there scope for a behavior change intervention such as a communications program to increase time in care for preschoolers in this vulnerable set of households?

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[16] Although it should be noted that the increased income from these activities should offset the lack of care received to some degree.

We noted from Table 4 that the nonwork (leisure) time of men increased as a result of VFC participation and for women leisure time was unaffected. Thus in the short-run there is perhaps scope for protecting childcare time by reducing time to leisure. This is not to say that leisure time is unimportant, particularly for the women upon whom the preschoolers primarily depend, but at least VFC participation has not increased overall work time burdens.

In the medium run, benefits may well accrue to unborn preschoolers if VFC participation empowers women. Although the amounts of income earned from the local sale of jams, jellies, and chips are quite small (Paolisso and Regmi 1992), they do represent the first opportunities women have had to earn and retain income without leaving the community. This may have far-reaching impacts on the ability of women in VFC households to exert their own preferences in a wide range of activities—including an increased allocation of resources to children. The current dataset does not permit a longer-run analysis of the impacts of this agricultural technology and training on the nutrition status of preschoolers, but future data collection efforts in this area of research should strive to do so.

APPENDIX TABLES

Table 5: Summary statistics for the survey sample

	All households (n=244)				Households with preschoolers (n=168)			
Summary statistics	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
Received VFC training	0.38	0.49	0.00	1.00	0.38	0.49	0.00	1.00
VFC participation (VFCP)	0.36	0.30	0.00	0.98	0.35	0.30	0.00	0.98
Head female, vegetable and fruit time	20.93	29.30	0.00	211.76	18.61	22.97	0.00	112.50
Head male, vegetable and fruit time	43.35	61.12	0.00	414.55	41.32	50.88	0.00	414.55
Head female cereal livestock time	228.13	136.70	0.00	508.24	220.57	134.70	0.00	508.24
Head male cereal livestock time	244.22	159.41	0.00	720.00	257.34	151.89	0.00	720.00
Head female care for <5 years	33.24	49.08	0.00	240.00	48.27	52.67	0.00	240.00
Head male care for <5 years	10.76	21.70	0.00	90.00	15.63	24.67	0.00	90.00
Head female leisure time	107.07	92.84	0.00	523.64	103.14	81.69	0.00	370.91
Head male leisure time	153.75	102.78	0.00	480.00	150.27	95.23	0.00	405.00
Log of household size	1.92	0.47	0.69	3.43	2.02	0.49	1.10	3.43
Male head of household = 1	0.95	0.23	0.00	1.00	0.97	0.17	0.00	1.00
Age of head of household (years)	40.82	11.86	18.00	75.00	39.29	12.34	18.00	75.00
Age of head of household squared	1,806.11	1,028.86	324.00	5,625.00	1,694.79	1,065.83	324.00	5,625.00
Head literate = 1	0.69	0.46	0.00	1.00	0.67	0.47	0.00	1.00
Age of head female (years)	31.39	8.98	15.00	49.00	30.42	8.37	16.00	49.00
Age of head female squared	1,065.91	574.30	225.00	2,401.00	995.13	535.85	256.00	2,401.00
Percent of males in household that are literate	75.69	38.11	0.00	100.00	75.30	38.12	0.00	100.00
Percent of females in household that are literate	14.56	29.44	0.00	100.00	11.03	24.02	0.00	100.00
1=Head male is literate, head female is not	0.74	0.44	0.00	1.00	0.79	0.41	0.00	1.00
Number children 0-4.9 years in household	1.30	1.21	0.00	6.00	1.89	1.00	1.00	6.00
Number of males 5-14 years in household	1.01	1.18	0.00	6.00	0.98	1.26	0.00	6.00
Number of females 5-14 years in household	0.98	1.17	0.00	5.00	1.08	1.22	0.00	5.00
Number of males 15-49 years in household	1.12	1.31	0.00	9.00	1.14	1.43	0.00	9.00
Number of females 15-49 years in household	0.77	1.08	0.00	6.00	0.90	1.19	0.00	6.00
Number of females >50 years in household	0.34	0.50	0.00	2.00	0.34	0.50	0.00	2.00
Dependency ratio of household (#<15 years/#>=15 years)	99.87	67.90	0.00	450.00	115.20	68.90	14.29	450.00
1=Improved house	0.40	0.49	0.00	1.00	0.40	0.49	0.00	1.00
1=Owns animal shed	0.83	0.38	0.00	1.00	0.81	0.39	0.00	1.00
1=Owns radio or cassette	0.35	0.48	0.00	1.00	0.37	0.48	0.00	1.00
Hectares owned per capita/20	0.40	0.53	0.00	5.00	0.34	0.47	0.00	5.00
1=Satbariya	0.35	0.48	0.00	1.00	0.38	0.49	0.00	1.00
1=Jinabang	0.34	0.48	0.00	1.00	0.36	0.48	0.00	1.00
Time to reach VFC office (minutes)	42.68	36.86	1.00	150.00	45.55	35.42	1.00	150.00

Table 6: Probit results for household participation in VFC

Determinants of VFC Participation	All households	Households with preschoolers
Male head of household = 1	-0.248	0.236
	(0.45)	(0.29)
Log of household size	0.732	-0.526
	(1.10)	(0.59)
Age of head of household (years)	0.046	0.011
	(0.83)	(0.17)
Age of head of household squared	-0.001	0.000
	(0.80)	(0.02)
Head literate = 1	0.696	0.949
	(1.97)*	(2.07)*
Percent of males in household that are literate	-0.001	0.000
	(0.17)	(0.07)
Percent of females in household that are literate	0.000	0.003
	(0.09)	(0.47)
Number children 0-4.9 years in household	-0.068	-0.036
	(0.57)	(0.21)
Number of males 5-14 years in household	0.034	0.272
	(0.30)	(1.79)
Number of males 15-49 years in household	-0.007	0.114
	(0.05)	(0.69)
Number of females 5-14 years in household	0.168	0.404
	(1.49)	(2.92)**
Number of females 15-49 years in household	-0.204	-0.300
	(1.25)	(1.38)
Number of females >50 years in household	-0.247	-0.198
	(1.02)	(0.66)
Total own land in hectares/20	0.031	0.053
	(1.24)	(1.78)
1=Improved house	0.228	0.035
	(0.49)	(0.05)
1=Owns animal shed	0.267	0.415
	(0.85)	(1.04)
1=Owns radio or cassette	0.342	0.228
	(1.54)	(0.85)
1=Satbariya	-0.702	-0.745
	(2.47)*	(2.08)*
1=Jinabang	1.287	1.490
	(2.53)*	(2.28)*
Time to reach VFC office (Minutes)	-0.016	-0.019
	(5.44)**	(5.00)**
Constant	-2.912	-1.281
	(2.23)*	(0.82)
Number of observations	244	168
Chi-squared	133.88	108.58
Probability > chi-square	0.0000	0.0000
Pseudo R-square	0.3730	0.4388

Table 7: Time allocation in cereals and livestock, vegetables and fruits: head men and women, households with preschoolers

	(1) OLS/IV	(2) OLS/IV	(3) Tobit/IV	(4) Tobit/IV
Only households with preschoolers	**Head female, cereal & Lvstk**	**Head male, & cereal Lvstk**	**Head female, vegetable and fruit**	**Head male, vegetable and fruit**
Log of household size	-34.603	49.731	-2.191	-0.163
	(0.56)	(0.47)	(0.10)	(0.00)
Male head of household = 1	-53.895	85.651	-2.526	4.041
	(0.92)	(0.57)	(0.12)	(0.10)
Age of head of household (years)	12.220	-5.778	-3.129	-1.658
	(1.88)	(0.67)	(1.65)	(0.51)
Age of head of household squared	-0.153	0.075	0.030	0.013
	(2.05)*	(0.76)	(1.38)	(0.35)
Head literate=1	4.191	-38.546	1.684	27.370
	(0.11)	(0.82)	(0.17)	(1.70)
Age of head female (years)	-7.566	2.583	-0.638	-6.247
	(0.75)	(0.20)	(0.24)	(1.40)
Age of head female squared	0.079	-0.035	0.030	0.102
	(0.55)	(0.17)	(0.77)	(1.58)
Percent of males in household that are literate	-0.004	0.204	-0.284	-0.142
	(0.01)	(0.24)	(1.69)	(0.61)
Percent of females in household that are literate	-0.648	-0.173	0.104	0.066
	(1.79)	(0.25)	(0.66)	(0.23)
1=Head male is literate, head female is not	-11.862	-10.554	17.107	2.469
	(0.25)	(0.17)	(1.16)	(0.11)
Number of males 5-14 years in household	-0.918	2.513	2.946	-9.038
	(0.10)	(0.17)	(0.88)	(1.59)
Number of females 5-14 years in household	-2.047	4.251	-2.961	-3.533
	(0.17)	(0.27)	(0.81)	(0.58)
Number of males 15-49 years in household	18.065	-6.501	-2.951	14.761
	(1.65)	(0.31)	(0.77)	(1.36)
Number of females 15-49 years in household	-4.529	-17.958	1.469	0.719
	(0.26)	(0.74)	(0.26)	(0.06)
Number of females >50 years in household	54.563	14.814	13.308	-14.302
	(2.33)*	(0.44)	(1.74)	(1.21)
Dependency ratio of household (#<15 yrs/#>=15 yrs)	0.023	-0.214	-0.042	0.195
	(0.11)	(0.69)	(0.53)	(1.36)
1=Improved house	-62.033	-84.012	-13.942	-48.856
	(1.19)	(1.67)	(0.78)	(2.00)*
1=Owns animal shed	15.152	35.718	6.423	-6.199
	(0.43)	(0.69)	(0.62)	(0.38)
1=Owns radio or cassette	4.937	-49.842	-0.090	3.640
	(0.22)	(1.61)	(0.01)	(0.35)
Hectares owned per capita/20	41.986	1.278	-6.276	-5.943
	(2.60)*	(0.06)	(0.74)	(0.76)
1=Satbariya	-197.950	-106.108	-4.736	29.827
	(7.66)**	(2.55)*	(0.47)	(2.01)*
1=Jinabang	27.784	4.475	-8.592	55.126
	(0.47)	(0.08)	(0.44)	(2.17)*
VFC Participation (VFCP)***	166.226	76.497	81.365	84.352
	(1.84)	(0.64)	(2.56)*	(2.23)*
Number children 0-4.9 years in household	48.742	29.675	8.126	9.268
	(3.37)**	(1.26)	(1.23)	(1.03)
VFCP*Number children 0-4.9 years	-101.717	-95.358	-25.785	-19.755
	(2.84)**	(2.10)*	(2.09)*	(1.15)
Constant	224.011	221.931	63.253	85.983
	(1.21)	(0.64)	(1.20)	(0.87)
Observations	168	168	168	168
R-squared	0.56	0.25		
Test of Joint Significance of VFC Coefficients	0.0199	0.0587	0.0367	0.0838

Notes: Robust t-statistics in parentheses; * significant at 5 percent level; ** significant at 1 percent level; *** treated as endogenous-identifying instrument is minutes to VFC office

Table 8: Time allocation in care and leisure: head men and women, households with preschoolers

	(5) Tobit/IV	(6) Tobit/IV	(7) OLS/IV	(8) OLS/IV
Only households with preschoolers	**Head female, care to <5s**	**Head male, care to <5s**	**Head female, leisure**	**Head male, leisure**
Log of household size	51.372	43.332	-36.189	-59.779
	(0.97)	(1.20)	(0.77)	(1.15)
Male head of household = 1	64.318	36.683	31.769	145.682
	(2.03)*	(0.98)	(1.08)	(3.41)**
Age of head of household (years)	-3.437	-4.306	3.434	0.892
	(0.89)	(1.59)	(1.01)	(0.20)
Age of head of household squared	0.021	0.047	-0.034	-0.008
	(0.44)	(1.52)	(0.89)	(0.15)
Head literate=1	-39.498	2.589	-18.974	-9.072
	(2.02)*	(0.16)	(0.93)	(0.29)
Age of head female (years)	-0.111	-3.803	-1.545	-4.728
	(0.02)	(0.65)	(0.27)	(0.63)
Age of head female squared	0.036	0.054	0.062	0.084
	(0.35)	(0.60)	(0.74)	(0.70)
Percent of males in household that are literate	0.492	0.252	0.346	0.449
	(1.34)	(0.76)	(0.88)	(0.86)
Percent of females in household that are literate	0.060	-0.240	-0.009	-0.568
	(0.16)	(0.73)	(0.02)	(1.52)
1=Head male is literate, head female is not	7.913	-14.897	-15.324	-42.469
	(0.31)	(0.57)	(0.49)	(1.11)
Number of males 5-14 years in household	-10.960	-14.870	-12.217	-10.184
	(1.25)	(1.94)	(1.54)	(1.14)
Number of females 5-14 years in household	-7.682	-16.522	-9.857	0.680
	(0.97)	(1.90)	(1.14)	(0.07)
Number of males 15-49 years in household	-14.585	8.534	-6.100	7.279
	(1.08)	(0.98)	(0.68)	(0.57)
Number of females 15-49 years in household	-11.920	-9.672	27.002	28.708
	(1.12)	(1.10)	(2.18)*	(1.88)
Number of females >50 years in household	-23.267	-32.692	-8.766	3.969
	(1.32)	(2.76)**	(0.51)	(0.20)
Dependency ratio of household (#<15 years/#>=15 years)	-0.123	0.226	-0.107	-0.025
	(0.75)	(1.57)	(0.76)	(0.11)
1=Improved house	-64.542	-0.494	14.896	14.351
	(2.09)*	(0.02)	(0.54)	(0.40)
1=Owns animal shed	-7.034	10.339	4.524	-28.964
	(0.35)	(0.82)	(0.28)	(1.07)
1=Owns radio or cassette	-0.116	14.309	12.335	8.017
	(0.01)	(1.16)	(0.83)	(0.45)
Hectares owned per capita/20	-18.281	-5.465	-47.176	19.083
	(1.59)	(0.50)	(3.69)**	(1.23)
1=Satbariya	32.805	-41.206	136.140	64.582
	(2.02)*	(2.86)**	(6.92)**	(2.67)**
1=Jinabang	106.157	1.915	33.198	-7.867
	(3.15)**	(0.07)	(1.08)	(0.20)
VFC Participation (VFCP)***	-157.826	-95.281	11.155	-104.270
	(3.05)**	(2.22)*	(0.22)	(1.37)
Number children 0-4.9 years in household	-15.807	-19.618	-1.033	-22.992
	(1.30)	(1.59)	(0.09)	(1.81)
VFCP*Number children 0-4.9 years	81.087	31.040	-4.354	96.314
	(3.44)**	(1.61)	(0.19)	(3.39)**
Constant	2.836	78.013	15.575	163.813
	(0.02)	(0.75)	(0.12)	(0.92)
Observations	168	168	168	168
R-squared			0.52	0.29
Test of Joint Significance of VFC Coefficients	0.0023	0.0845	0.9743	0.0022

Notes: Robust Z-statistics in parentheses, * significant at 5 percent level; ** significant at 1 percent level; *** treated as endogenous-identifying instrument is minutes to VFC office

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